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(54) Low-stress shielded exhaust passage assemblies.

(57) An exhaust manifold or cylinder head (11) of an internal combustion engine is provided with a low-stress passage assembly (19,20,22) comprising a plurality of separate housings (23; 44; 60), each of which has a tubular insulating shield (38; 55; 74) extending therein, each shield having ball-like ends - (39,40,42; 56,58; 75,76,78). The ball-like ends are seated on bearing rings (34,35,36; 52,54; 70,71,72) preferably cast or inserted into the housing ends - (24,26,27; 46,47; 62,63,64) to provide for relative expansion of the insulating shields (38; 55; 74) with respect to the corresponding housings (23; 44; 60), both linear and bending expansion motions being accommodated. The separate housings (23; 44; 60) may be formed by casting the housings around their respective shields. Sand core material may be pre-applied to create the desired insulating clearance between the associated housing and shield, and, if desired, to secure the bearing rings in position.

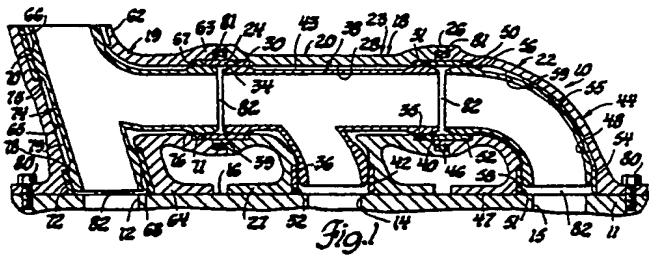

Fig.1

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LOW-STRESS SHIELDED EXHAUST PASSAGE ASSEMBLIES

Field

This invention relates to shielded exhaust passage assemblies, such as engine exhaust manifolds, and cylinder heads. In particular, the invention relates to low-stress shielded exhaust passage assemblies and methods for their construction.

Background

It is known in the art relating to internal combustion engines to provide shields, or inner passage-defining members, in exhaust passage means such as cylinder head exhaust ports, and exhaust manifolds. Various types of shields, or inner linings, have been provided for different purposes. One purpose has been to insulate the exhaust passages to reduce the outer skin temperature. Another has been to reduce the loss of engine exhaust heat prior to delivery to another device such as an exhaust turbocharger for using the high temperature exhaust energy or an exhaust treatment device such as a catalytic converter for supporting combustion reactions in the exhaust gases.

Depending upon the construction of and materials used in such shielded exhaust passage assemblies, the temperature changes occurring in the exhaust systems may result in severe stresses due to differential expansion of various portions of the inner shield members and the outer housing members. However, slip joints and other devices have been previously used to accommodate such stresses.

For example, U.S.-A-3 775 979 discloses an exhaust passage assembly for an internal combustion engine, said assembly comprising a housing defining a passage for the transmission of engine exhaust gases therethrough, the passage having at least two spaced ends opening outwardly of the housing, and a tubular shield within the passage and extending between said spaced ends.

A low-stress exhaust passage assembly according to the present invention comprises such a housing and is characterised in that there are internal bearing means in the housing at each of the ends of said housing, at least one of the bearing means being of at least part-cylindrical form, and said shield has ball-like ends, each one of which engages a respective one of the bearing means to fix the lateral position of the shield within the housing, said ball-like shield ends providing slip joints within the respective bearing means to allow freedom for rotational motion, and said part-cylindrical bearing means also permitting free axial motion of the ball-like end associated therewith.

The present invention provides improved forms of low-stress shielded exhaust system assemblies for engine exhaust manifolds, cylinder heads and equivalent devices. Novel internal shield arrangements having slip-jointed end connections with the housing members of their respective assemblies are utilized to provide low cost, low-stress shielded exhaust passage assemblies capable of manufacture by currently available techniques.

These and other features and advantages of the invention will be more fully understood from the following description of selected embodiments taken together with the accompanying drawings.

Drawings

In the drawings:

Figure 1 is a cross-sectional view of an engine having a modular exhaust manifold made up of low-stress shielded exhaust system assemblies formed in accordance with the invention.

Figure 2 is a cross-sectional view of a centre assembly of the manifold of Figure 1.

Figure 3 is a cross-sectional view of an inlet end assembly of the manifold of Figure 1.

Figure 4 is a cross-sectional view of an outlet end assembly of the manifold of Figure 1.

Figure 5 is a cross-sectional view showing an optional arrangement for sealing gaps between the ends of shields of adjacent manifold sections, and

Figure 6 is a cross-sectional view showing an optional form of shield mounting arrangement in an exhaust system assembly.

Description

In the drawings, numeral 10 generally indicates an internal combustion engine having a cylinder head 11 including a plurality of axiallyaligned exhaust ports 12, 14, 15 opening through an outer wall 16 of the cylinder head. Secured to this outer wall 16 is a modular exhaust manifold 18 made up of low-stress shielded exhaust passage assemblies. These assemblies include an outlet passage assembly 19, a centre passage assembly 20 and an inlet passage assembly 22, all formed in accordance with the invention and shown individually in Figures 2, 3 and 4.

The centre passage assembly 20, shown in Figure 2, preferably includes a cast housing having male and female connecting ends 24, 26, respectively, and a flanged inlet end 27, all interconnected by an internal cavity 28. At the housing ends in the cavity there are internal cylindrical counterbores 30, 31, 32 in which are disposed associated bearing rings 34, 35, 36 respectively. For purposes to be subsequently made clear, the ring 34 at the male end protrudes beyond the counterbore 30, the ring 35 at the female end is recessed from the end of the counterbore 31 and the ring 36 at the flanged inlet end extends flush with the end of the counterbore 32.

Within the cavity 28 and seated on the bearing rings 34-36, there is a tubular internal passage-defining shield 38. This shield is essentially co-extensive with the cavity 28 and includes three associated ball-ends 39, 40, 42 seated respectively on the bearing rings 34, 35, 36.

The ball ends 39,40,42 sliding on the bearing rings 34,35,36 allow the internal shield 38 to expand by sliding and turning in the bearing rings with respect to the cast housing 23. The housing 23 is of one-piece construction rather than the assembled two-piece housing shown in US-A-3,775 979.

Intermediate the ball-ends, the exterior of the shield 38 is of slightly reduced diameter so as to provide a clearance 43 between the exterior of the shield 38 and the interior of the cavity 28. The clearance 43 is of any suitable dimension and is preferably selected to provide an optimum thickness of heat-insulating dead air space to minimize the transfer of heat from the passage defined by the interior of the shield 38 to the housing which internally defines the cavity 28.

The inlet and outlet end passage assemblies 22, 19, respectively, are constructed in a fashion similar to that of the centre passage assembly 20 just described. Accordingly, description of these assemblies will avoid repetition of similar detail and will concentrate upon the differences in the constructions.

The inlet passage assembly 22 includes a housing 44 which has a male connecting end 46, a flanged inlet end 47 and internally defines a curved cavity 48. Counterbores 50, 51 at the ends are respectively provided with inserted cylindrical bearing rings 52, 54 which respectively protrude and are flush with the ends of their respective counterbores. An internal shield 55, having outlet and inlet ball-ends 56, 58, seated on the bearing rings 52, 54, respectively, also includes a reduced diameter intermediate portion forming a clearance 59 between the inner cavity defining wall of the housing 44 and the outer surface of the shield 55.

In similar fashion, the outlet end passage assembly 19, shown in Figure 4, includes a housing 60 having an outlet end 62, a female connecting end 63 and an inlet end 64. Counterbores 66, 67, 68 in the ends are provided with bearing rings 70, 71, 72 respectively which are flush with or, in the case of ring 71, recessed in their counterbores. A shield 74 within the cavity has ball-ends 75, 76, 78 seated on the bearing rings 70, 71, 72 respectively. A reduced diameter portion intermediate the ball ends defines an insulating clearance 79 between the shield and the inner wall of the cavity 65.

In installation of the manifold on an engine, the individual passage assemblies 19, 20 and 22 are secured to the cylinder head 11 with their inlet passages aligned with the respective exhaust ports 12, 13, 15. Bolts 80 extend through the flanges of the flanged inlet ends 27, 47, 64, to retain the assemblies 19, 20, 22 against the outer wall 16 of the head 11.

During installation, the individual assemblies are interconnected, the male connecting ends 24, 46 of assemblies 20, 22 being inserted within the female connecting ends 63, 26 of assemblies 19 and 20, respectively. Also, the protruding portions of bearing rings 34, 52 extend into the spaces left by the recessed bearing rings 71, 35 to aid in properly aligning the internal passages defined by the interconnected assemblies and their inner shields 74, 38, 55. Preferably, high temperature seals 81 are installed in annular gaps between the male and female housing ends to prevent external leakage of exhaust gases through these expansion joints.

As assembled, the separate housing elements making up the exhaust manifold are permitted some relative motion due to the expansion joints between them which are sealed by seals 81. In addition, the separate shield members 74, 38, 55 within the housing are free to expand or contract relative to their housings with free movement being permitted by sliding motion of the ball-ends on their respective bearing rings. The separate sections 19, 20, 22 of the exhaust manifold also allow expansion relative to the cylinder head 11 to which they are bolted.

Gaps 82 are provided between adjacent ends of the shields and between the inlet ends of the shields and the adjacent wall 16 of the cylinder head to provide freedom for longitudinal expansion of the inner shields without engaging one another or the cylinder head wall. If desired, these gaps may be closed by suitable high temperature seal members. As an example, Figure 5 illustrates a connecting joint between passage assemblies 19 and 20 with a seal in the form of a spring-steel ring 83 added.

Various alternative embodiments of the bearing rings and connecting end portions of the shield members may be provided as indicated, for example, in Figure 6 wherein an alternative embodiment of passage assembly is illustrated. In this embodiment, numeral 86 represents a housing, such as an engine cylinder head, defining an exhaust port 87 opening to an outer wall 88. A bearing ring 90 is mechanically locked by projections 91 into an annular recess at the outer end of the exhaust port and receives a cylindrical end 92 of a shield 94 disposed within the exhaust port 87. A radial lip 95 on the bearing ring prevents the shield 94 from sliding out of the port whilst allowing room for relative expansion of the shield to occur with respect to the cylinder head housing 86.

A cylindrical end 92 may be utilized instead of a ball-end at locations where it is expected that longitudinal motion of the associated parts will be sufficient to accommodate relative expansion and substantial bending or other expansion effects will not be encountered.

The construction of an exhaust manifold, cylinder head or other passage assembly having the features of the invention so far disclosed may be accomplished in any suitable manner.

A preferred method of making embodiments of the invention as specifically heretofore disclosed is to first form the shield members, such as by casting and, if necessary, machining the ball or cylindrical ends. Thereafter, the individual shield members are encapsulated within sand core material formed with a thickness about the shield members equal to the clearance desired between the shield and the outer housing. At this time the bearing rings may also be placed in position on the ball ends and sand core material packed in to fill any gaps desired to be left between the end portions of the shields and the bearing rings.

Subsequently, the prepared inserts are placed in moulds and the outer housings of the passage assemblies are cast thereabout using cast iron, steel, aluminium or other suitable material.

Finally, the cast assemblies are removed from their moulds and cleaned, the core sand being removed from the insulating spaces inside the housings and surrounding the shields. If desired, such sand removal may be accommodated by providing in the ball-ends, or in the bearing inserts, longitudinal grooves or spaces, not shown. Final machining of the ends of the housings and bearing rings to properly fit with one another or their associated elements may then be accomplished and the assemblies are thus ready for installation on, for example, an engine.

It should be understood that numerous changes or modifications of the concepts disclosed herein could be provided, if desired. For example, the housing members could be provided with flanges, not shown, at their associated male and female connecting ends. The flanges could then be bolted together so that a complete manifold assembly would be provided for installation on an engine as one unit rather than a series of separate assemblies. Such an arrangement would eliminate the relative expansion provision for the separate housing units but would permit relative expansion of the internal shield elements in the same manner as previously described.

Claims

1. A low-stress exhaust passage assembly (19; 20; 22) for an internal combustion engine (10), said assembly comprising a housing (23; 44; 60) defining a passage for the transmission of engine exhaust gases therethrough, the passage having at least two spaced ends (24,26,27; 46,47; 62,63,64) opening outwardly of the housing, and a tubular shield (38; 55; 74) within the passage and extending between said spaced ends (24,26,27; 46,47; 62,63,64), characterised in that there are internal bearing means (34,35,36; 52,54; 70,71,72) in the housing (23; 44; 60) at each one of said ends - (24,26,27; 46,47; 62,63,64), at least one of the bearing means being of at least part-cylindrical form, and said shield (38; 55; 74) has ball-like ends (39,40,42; 56,58; 75,76,78), each one of which engages a respective one of the bearing means - (34,35,36; 52,54; 70,71,72) to fix the lateral position of the shield (38; 55; 74) within the housing, said ball-like shield ends (39,40,42; 56,58; 75,76,78) providing slip joints within the respective bearing means (34,35,36; 52,54; 70,71,72) to allow freedom for rotational motion, and said part-cylindrical bearing means also permitting free axial motion of the ball-like end associated therewith.

2. A low-stress exhaust passage assembly (19; 20; 22) according to claim 1, characterised in that the passage includes a directional change between its ends (24,27; 46,47; 62,63), and the bearing means (34,36; 52,54; 70,71) at said spaced ends - (24,27; 46,47; 62,63) are non-coaxial to one another.

3. A low-stress exhaust passage assembly (19; 20; 22) according to claim 1, characterised in that the passage includes at least one branch, each such branch including one of the passage ends - (27; 63) provided with said bearing means (36; 71), said bearing means (36; 71) of each of said branches being additionally of part-cylindrical form.

4. A low-stress exhaust passage assembly (19; 20; 22) according to claim 1, characterised in that said ball-like ends (39,40,42; 56,58; 75,76,78) are part-spherical and said bearing means (34,35,36; 52,54; 70,71,72) comprise separate rings.

5. A low-stress exhaust passage assembly (19; 20; 22) according to claim 1, characterised in that said housing (23; 44; 60) is cast around said bearing means (34,35,36; 52,54; 70,71,72) with said shield (38; 55; 74) in place.

6. A low-stress exhaust passage assembly - (19,20,22) for an internal combustion engine (10), said assembly comprising a housing assembly - (23,44,60) defining a passage for the transmission of engine exhaust gases therethrough, the passage having at least two spaced ends (27,47,62,64) opening outwardly of the housing, and a tubular shield (38,55,74) within the passage and extending between said spaced ends (27,47,62,64), characterised in that the housing assembly comprises a plurality of housings (23; 44; 60), each of which defines a passage for the transmission of engine exhaust gases therethrough, each passage having at least two spaced ends (24,26,27; 46,47; 62,63,64) opening outwardly of its respective housing (23; 44; 60), said housings (23; 44; 60) being connectable to one another to form a single housing assembly with a continuous passage therethrough; there are internal bearing means (34,35,36; 52,54; 70,71,72) in each housing (23; 44; 60) at each one of said spaced ends (24,26,27; 46,47; 62,63,64), at least one of the bearing means of each housing being of at least part-cylindrical form; there is a tubular shield (38; 55; 74) within each passage which extends between the spaced ends, and each one of said shields (38; 55; 74) has ball-like ends (39,40,42; 56,58; 75,76,78), each one of which engages a respective one of the bearing means (34,35,36; 52,54; 70,71,72) to fix the lateral position of the shield (38; 55; 74) within the associated housing, said ball-like shield ends (39,40,42; 56,58; 75,76,78) providing slip joints within the respective bearing means (34,35,36; 52,54; 70,71,72) to allow freedom for rotational motion, and each one of said part-cylindrical bearing means also permitting free axial motion of the ball-like end associated therewith.

7. A low-stress exhaust passage assembly - (19,20,22) according to claim 6, characterised in that there is a gap (82) provided between adjacent ends (39,76) of adjoining shields (38,74), which gap is sealed by a spring-steel ring (83).

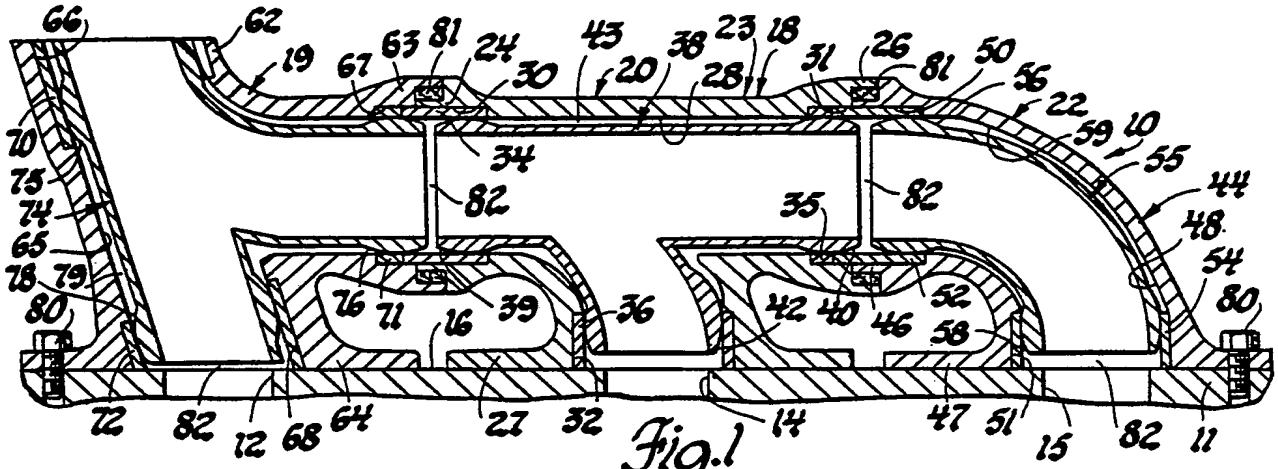

Fig.1

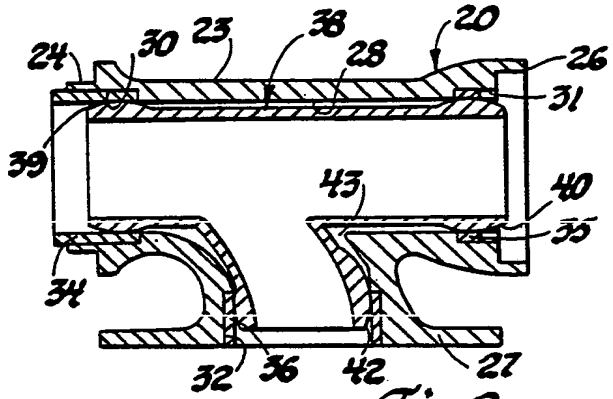

Fig.2

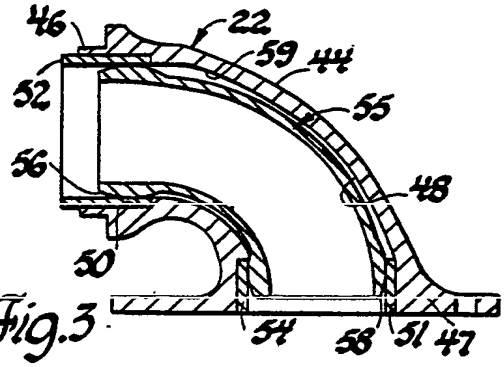

Fig.3

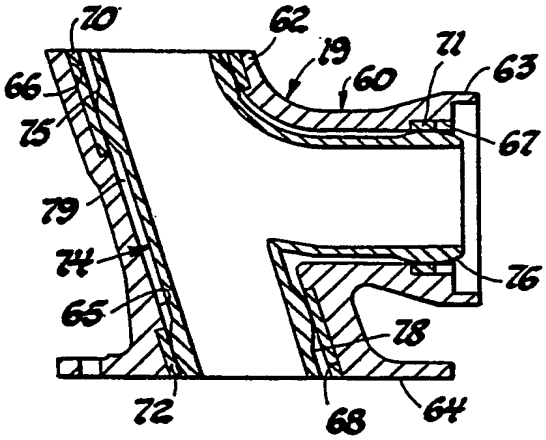

Fig.4

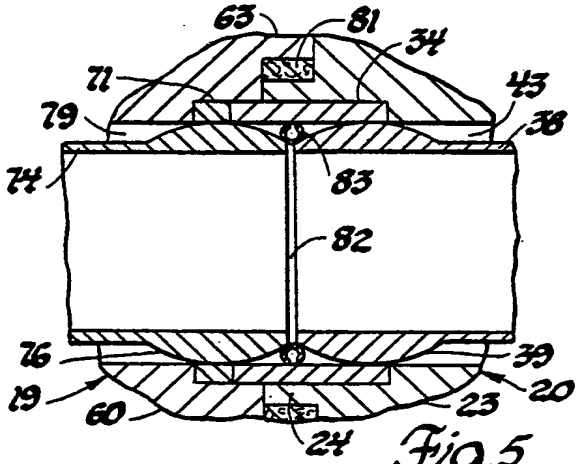

Fig.5

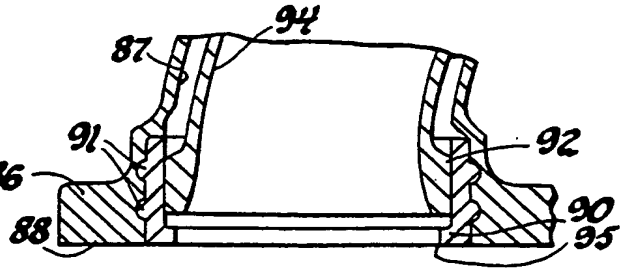

Fig.6

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87 30 0033

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A,D	US-A-3 775 979 (SCHEITLIN) * Column 2, line 16 - column 3, line 16; figure 1 *	1-3	F 01 N 7/10
A	US-A-4 168 610 (ENGQUIST) * Column 2, line 49 - column 3, line 12; figures 1,2 *	1,4,6, 7	
A	GB-A-2 138 904 (PRESSURE SCIENCE) * Page 4, lines 16-87; figure 5 *	1,4	
A	GB-A-2 083 154 (PICKUP) * Whole document *	1,4	
A	EP-A-0 079 511 (DEERE)		TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 01 N F 16 L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22-05-1987	FRIDEN C.M.

CATEGORY OF CITED DOCUMENTS

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